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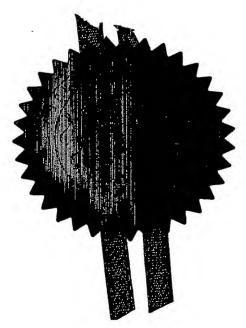
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2. Patent application number (The Patent Office will fill in this part)

111 SEP 2003

0321287.5

Full name, address and postcode of the or of each applicant (underline all surnames)

00001881500

Patents ADP number (if you know to)

If the applicant is a corporate body, give the country/state of its incorporation

Safeglass (Europe) Limited Whitworth Building Scottish Enterprise Technology Park East Kilbride GLASGOW G75 0QD

UK

Title of the invention

Glass like material with improved safety characteristics

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (Including the postcode)

Kennedys Patent Agency Limited Floor 5, Queens House 29 St Vincent Place Glasgow **G1 2DT**

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Country

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Description

13 /

Claim(s)

Abstract

Jun

Drawing (4)

1 only

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I/We request the grant of a patent on the basis of this application.

iedas Reverpla

Date 11 September 2003

 Name and daytime telephone number of person to contact in the United Kingdom Karen Veitch

Tel: 0141 226 6826

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Glass like material with improved safety characteristics. 1 2 3 The present invention relates to a glass-like material 4 which has improved safety characteristics compared to 5 ordinary glass. 6 Marian Barrier In the present Application references to a "glass-like" 7 material refer to a material having the following 8 characteristics; clarity, brittleness, low strain to 9 failure and rigidity. 10 11 12 Ordinary glass is used in a variety of everyday 13 applications. For example it is known in the art to use glass as a protective covering over fire and other types 14 15 of emergency alarms, emergency door releases, emergency 16 stop buttons on public transport, fire extinguishers, 17 fire axes and the like. As glass is transparent persons 18 can quickly and easily identify the presence of the alarm 19 or apparatus in the retaining box. If required, the 20 glass can be broken in order to access the alarm or 21 device. 22

However an inherent problem lies in the manner in which

the glass can be broken. Often a subsidiary device such

l as a hammer is supplied with, or near to, the alarm or

- 2 apparatus, and can be used to break the glass. However,
- 3 in the event that this device is missing or cannot be
- 4 located in an emergency situation it will be necessary
- 5 for the person who wishes to access the apparatus or
- 6 alarm to break the glass by some other means. In the
- 7 event of an emergency situation the person may use, for
- 8 example, a hand or elbow for this purpose, and may, as a
- 9 result, sustain injuries from breaking the glass.
- 10 Breakage of glass results in the production of sharp
- 11 glass fragments and splinters, which can cause injury to
- 12 the user or other persons in the proximity of the alarm
- 13 or apparatus. In addition the potential risk of injury
- I4 from breaking the glass may cause hesitation on the part
- 15 of the person who wishes to access the alarm or
- 16 apparatus, having dangerous consequences.

17 (1994) 1994 (1994) 1994 (1994) 1994 (1994)

- 18 The glass may also be broken by malicious or accidental
- 19 damage. Whilst the glass fragments can be removed and
- 20 the retaining glass replaced, there is an interim risk of
- 21 injury to persons coming into contact with the broken
- 22 fragments.

23.

- 24 Considerable research has been conducted to find
- 25 materials which can be used in Applications similar to
- 26 glass but which minimise the risk of damage to persons in
- 27 the instance of the material being broken either
- 28 intentionally or accidentally. Safety glass i.e.
- 29 toughened glass, materials are well known in the art and
- 30 have numerous applications and uses. Most have enhanced
- 31 safety by virtue of being reinforced in strength, such
- 32 that they have a higher stress to failure than glass; in
- 33 other words a greater force is needed to shatter or break
- 34 them than would be required with ordinary glass. Uses

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- l vary from windows and doors on automobiles and public
- 2 transport, to domestic uses such as shower enclosures and
- 3 room partitions. Whilst in many instances these have
- 4 greatly increased safety, they are of limited use in
- 5 Applications where it is actually desirable for the glass
- 6 to be broken, i.e. when used on retaining boxes of
- '7 emergency apparatus and alarms, because of their enhanced
 - 8 strength and resistance to force.

9

- 10 For example the polymeric materials Perspex and
- 11 Plexiglas M, are transparent like glass, and do not pose
- 12 the same risk of injury when broken. However, these
- 13 materials can be harder to break than glass and can still
- 14 produce sharp fragments when broken.

,15

- 16 It is therefore an object of the present invention to
- . 17 provide a material which resembles glass, but which has
- 18 improved safety characteristics when compared to ordinary
 - 19 glass.

20

- 21 According to a first aspect of the present invention
- 22 there is provided a material which shatters, when broken,
- 23 into fragments which do not cut, puncture or otherwise
- 24 damage human skin or tissue, wherein the material is
- 25 comprised of an amorphous thermoplastic polymer and one
- 26 · or more low molecular weight resins.

27

- 28 Preferably the material is comprised of a simple mixture
- 29 of amorphous thermoplastic polymer and one or more low
- 30 molecular weight resins.

- 32 Preferably the amorphous thermoplastic polymer is chosen
- 33 from the group consisting of polystyrene (PS), polymethyl
- 34 methacrylate (FMAA), styrene-acrylonitrile copolymer

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1 (SAN), linear polyesters and co-polyesters and

2 polycarbonate (PC).

3

4 The one or more low molecular weight resins chosen will

- 5 be completely compatible with the chosen polymer. For
- 6 example in the case of polystyrene the low molecular
- 7 weight resin is typically C9 aromatic hydrocarbon resin.

8

- 9 Preferably the material has a tensile stress limit of
- 10 between 11 and 60 Nmm⁻².

. 11

- 12 Preferably the low molecular weight resin will have a Mn
- 13 (number average molecular weight) such that it has less
- 14 than 500 repeating units, and preferably less than 50
- 15 repeating units.

16

17 The material may be manufactured in sheet form:

980.0 cd 18

- 19 According to a second aspect of the present invention
- 20 there is provided a polymeric blend comprising a polymer
- 21 selected from the group consisting of: polystyrene, (PS),
- 22 polymethyl methacrylate (PMAA), styrene-acrylonitrile
- 23 copolymer (SAN), linear polyesters and co-polyesters and
- 24 polycarbonate (PC) and one or more low molecular weight
- 25 resins.

26

- 27 The one or more low molecular weight resins chosen will
- 28 be completely compatible with the chosen polymer. For
- 29 example in the case of polystyrene the low molecular
- 30 weight resin is typically C9 aromatic hydrocarbon resin.

- 32 Preferably the one or more low molecular weight resins
- 33 have a Mn (number average molecular weight) such that it

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5

- 1 has less than 500 repeating units, and preferably less
- 2 than 50 repeating units.

3

- 4 Preferably the one or more low molecular weight resins
- 5 are hydrocarbon resins.

6

- 7 Preferably the one or more low molecular weight resins
- 8 are aromatic hydrocarbon resins.

9

10 The polymeric blend may be manufactured in sheet form.

11

- 12 According to a third aspect of the present invention
- 13 there is provided a material which shatters, when broken,
- 14. into fragments which do not cut, puncture or damage human
 - 15 skin or tissue, the material being comprised of
 - 16 polystyrene and one or more low molecular weight resins.

- 2 18 Preferably the material is comprised of a simple mixture
- 19. of polystyrene and one or more low molecular weight
 - ...20 resins.

21

- 22 Preferably the one or more low molecular weight resins
- 23 are hydrocarbon resins.

24

- 25 Preferably the one or more low molecular weight resins
- 26 are aromatic hydrocarbon resins.

27

- 28 Most preferably the one or more low molecular weight
- 29 hydrocarbon resins are C9 aromatic hydrocarbon resins.

30

- 31 Freferably the one or more low molecular weight resins
- 32 are, or are derived from, alpha methyl styrene.

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- 1 Preferably the one or more low molecular weight
- 2 hydrocarbon resins are selected from a group consisting
- 3 of; Norsolene[™], Kristalex[™], Plastolyn[™] Endex[™],
- 4 Piccotexm, Piccolasticm, Sukorezm or Arkonm.

5

- 6 Most preferably the one or more low molecular weight
- 7 hydrocarbon resins are selected from a group consisting
- 8 of; Norsolene W90™, Norsolene W100™, Norsolene W110™,
- 9 Kristalex F85 TM, Kristalex F100 TM, Kristalex F115 TM,
- 10 Plastolyn 240 [™], Plastolyn 290 [™], Endex 155 [™],
- 11 Piccolastic Dl25 TM, Sukorez 100 TM, Sukorez 120 TM, Arkon
- 12 P100 ™, Arkon P125 ™, Arkon P140 ™, Piccotex 75 ™,
- 13 Piccotex 100 ™ or Piccotex 120 ™.

- 15 Preferably the one or more low molecular weight resins
 - 16 will have a Mn (number average molecular weight) such 🖑 🤫 🦠
 - ... 4 17 that it has less than 500 repeating units, and preferably with said
 - 18 18 less than 50 repeating units.

19

- 20 Preferably the material has a tensile stress limit
- 21 between 11 and 60 Nmm^{-2} .

22

- 23 Optionally the material may also include UV inhibitors,
- 24 antioxidants, flow modifiers, fire retarding agents,
- 25 colour pigments and brighteners as known in the art.

26

27 The material may be manufactured in sheet form.

- 29 According to a fourth aspect of the present invention
- 30 there is provided a method of manufacturing a material
- 31 which shatters, when broken, into which do not cut,
- 32 puncture or damage human skin or tissue, the method
- 33 comprising the step of mixing an amorphous thermoplastic
- 34 polymer and one or more low molecular weight resins.

Preferably the amorphous thermoplastic polymer is chosen from the group consisting of polystyrene (PS), polymethyl methacrylate (PMAA), styrene-acrylonitrile copolymer (SAN), linear polyesters and co-polyesters and polycarbonate (PC).

8 Preferably the one or more low molecular weight resins

9 are completely compatible with the chosen polymer. For

10 example in the case of polystyrene preferably the chosen

11 low molecular weight resin is C9 aromatic hydrocarbon

12 resin.

13

14 Preferably the one or more low molecular weight resins

15 are hydrocarbon resins.

17 Preferably the one or more low molecular weight resins of the second

18 are aromatic hydrocarbon resins.

19

20 Preferably the low molecular weight resin will have a Mn

21 (number average molecular weight) such that it has less

22 than 500 repeating units, and preferably less than 50

23 repeating units.

24

25 Freferably as the polystyrene is mixed with the one or

26 more low molecular weight hydrocarbon resins, the glass

27 transition temperature (T_g) of the material is elevated.

28 Typically the Tg is elevated to 5-10 degress C higher

29 than the base polymer.

30

31 According to a fifth aspect of the present invention

32 there is provided a method of manufacturing a material

33 which shatters, when broken, into fragments which do not

34 cut, puncture or damage human skin or tissue, the method

30 30000

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comprising the step of mixing polystyrene and one or more

low molecular weight hydrocarbon resins. 2

3

Preferably the one or more low molecular weight resins 4

are hydrocarbon resins. 5

6

Preferably the one or more low molecular weight resins 7

are aromatic hydrocarbon resins. 8

9

10 Most preferably the one or more low molecular weight

hydrocarbon resins are C9 aromatic hydrocarbon resins. 11

12

Preferably the one or more low molecular weight resins 13

are, or are derived from, alpha methyl styrene. 14

15

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Preferably the one or more low molecular weight 16

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17 hydrocarbon resins are selected from a group consisting way.

of; NorsoleneTM, KristalexTM, PlastolynTM EndexTM, 18

19 Piccotexm, Piccolasticm, Sukorezm or Arkonm.

20

21 Most preferably the one or more low molecular weight

22 hydrocarbon resins are selected from a group consisting

of; Norsolene W90TM, Norsolene W100TM, Norsolene W110TM, 23

Kristalex F85 TM, Kristalex F100 TM, Kristalex F115 TM, 24

25 Plastolyn 240 TM, Plastolyn 290 TM, Endex 155 TM,

Piccolastic D125 ™, Sukorez 100 ™, Sukorez 120 ™, Arkon 26

Pl00 ™, Arkon Pl25 ™, Arkon Pl40 ™, Piccotex 75 ™, 27

Piccotex 100 TM or Piccotex 120 TM. 28

29

30 Preferably the low molecular weight resin will have a Mn

31 (number average molecular weight) such that it has less

than 500 repeating units, and preferably less than 50 32

33 repeating units.

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1 The method may comprise the optional step of adding an

2 additive selected from the group consisting of UV

3 inhibitors, antioxidants, flow modifiers, fire retarding

4 agents, colour pigments and brighteners as known in the

5 art.

6

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7 Preferably as the polystyrene is mixed with the one or

- 8 more low molecular weight hydrocarbon resins, the glass
- 9 transition temperature (T_g) of the material is elevated.
- 10 Typically the Tg is elevated to 5-10 degress C higher
- 11 than the base polymer.

12

- 13 The material herein described can be used as a substitute
- 14 for ordinary glass. The material is glass-like in
- 15 character having clarity, brittleness, low strain to
- 16 failure and rigidity of the material has a variety of uses
- 17 including application as enchosures and boxes to house
- 18 emergency equipment e.g. keys; first aid boxes, fire
- 19 extinguisher, window hammers; emergency stop buttons,
- 20 emergency kick out panels and alarms, as well as use in
- 21 access panels, windows and doors. It should be
- 22 recognised that the abovedescribed uses are by way of
- 23 example only and are not intended to limit the manner in
- 24 which the material is used. The material can be
- 25 manufactured in sheet form, by extrusion, and moulded
- 26 into any shape by injection moulding or other standard
- 27 melt processes.

28

- 29 Table 1 shows the stress-strain behaviour of the material
- 30 in comparison to other polystyrene materials. Figure 1
- 31 shows this information in the form of a graph.

32

Table	:	Comparison	ΩÍ	Properties	٥£	Safaglass ^m	to	Polyst	yrenes.
		Modulus		yield v	telo	Stross	-	rnaia	iri mata

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Folymer Type:	/ GPa	stress / MPa	strain / %	at break / MPa	at break	softening temperature
Polystyrene (i.s. "crystal" or GPPS)	3.0 - 3.2	Brittle -	no yield	4 75	2	82 - 98
Toughened polystyrene (e.g. HIPS)	1.6 - 2.4	18 - 38	1.5	< yield	15 - >50	76 -95
Safeglans TM	3.1 - 3.4	Brittle - no yield		8 - 40	1 - 2	95 - 104

N.B. Safeglass™ materials are slighly more rigid and

certainly more brittle than conventional 3

"crystal"polystyrene. Modified polystyrenes are 4

invariably less rigid and tougher materials as a result 5

of blending with a rubbery (low Tg) additive. This also 6

results in a lowering of the Glass Transition Temperature 7

 (T_{σ}) as witnessed by the reduction in the Vicat Softening 8

Temperature. The reverse is true of Safeglass materials . 9

which show no such decrease in Tg , indeed it can be 10

11

higher than c. and the three of a market and the

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THE RESERVE OF THE PROPERTY OF The material is fundamentally a blend of a rigid and 13

normally brittle amorphous thermoplastic with a glass 14

transition temperature Tg at least 5° C above ambient and 15

one or more compatible low molecular weight resins. 16

17

An example embodiment will now be described by way of 18

19 example only.

20

A rigid and normally brittle amorphous thermoplastic 21

polymer is blended with one or more low molecular weight 22

resins which have a Mn (number average molecular weight) 23

such that the resin has less than 500 repeating units, 24

preferably less than 50 repeating units. The one or more 25

low molecular weight resins have a weight average 26

molecular weight of 6050 or below. 27

- 1 The material is manufactured by mixing or blending a
- 2 clear polymer with one or more low molecular weight
- 3 hydrocarbon resins. The polymer is an amorphous
- 4 thermoplastic and can be chosen from the group of
- 5 polystyrene, (PS), polymethyl methacrylate (PMAA),
- 6 styrene-acrylonitrile copolymer (SAN), linear polyesters
- 7 and co-polyesters and polycarbonate (PC). It is important
- & that the low molecular weight resin is completely
- 9 compatible with the chosen polymer. For example in the
- 10 case of polystyrene it is C9 aromatic hydrocarbon resin.

11

12 In the herein described embodiment polystyrene is used.

13

- 14. The one or more low molecular weight besins which are
 - 15 mixed with the polystyrene are aromatic hydrocarbon
 - 16 resins and typically C9 aromatic hydrocarbon resins.
- 17 The one or more resing are typically malpha methyl styrene . --
 - 18 or vinyl toluene or derivatives thereof. These are
 - 19 selected from the following group: Norsolene W90TM,
 - 20 Norsolene W100TM, Norsolene W110TM, Kristalex F85 TM,
 - 21 Kristalex F100 ™, Kristalex F115 ™, Plastolyn 240 ™,
 - 22 Plastolyn 290 ™, Endex 155 ™, Piccolastic D125 ™, Sukorez
 - 23 100 TM, Sukorez 120 TM, Arkon Pl00 TM, Arkon Pl25 TM, Arkon
 - 24 P140 TM, Piccotex 75 TM, Piccotex 100 TM or Piccotex 120 TM.

- 26 It has been discovered that by blending polystyrene with
- 27 one or more of the abovementioned low molecular weight
- 28 hydrocarbon resins, a hard, rigid material is formed
- 29 which has the appearance and feel of glass, but which is
- 30 extremely brittle and has low strain to failure. The
- 31 material also has the inherent advantage that when
- 32 broken, unlike glass, the material breaks into fragments
- 33 which are not sharp and do not injure skin or tissue. The
- 34 material is, by design, manufactured to break between 11

1 and 60 Nmm⁻². Therefore the material, when provided as a

- 2 substitute to glass, for example in retaining boxes for
- 3 emergency devices and alarms, can easily be broken by a
- 4 human hand, fist, elbow, foot or the like and
- 5 advantageously shatters into fragments or pieces which
- 6 are not sharp and are not capable of cutting or
- 7 puncturing human skin. Due to the inherent advantages of
- 8 the material it is envisaged that it may have a variety
- 9 of other uses, for example it may have application in
- 10 novelty toys, such as stress relief toys, or have uses in
- 11 "stunt" apparatus in, for example, theatres, shows or on
- 12 film sets.

13

- 14 The material is manufactured by conventional melt
- . The polystyrene is mixed with the compounding techniques. As the polystyrene is mixed with
 - thou 16 the one or more low molecular weight hydrocarbon resins,
 - THE WAR 170 the glass transition temperature (Tg) of the material is
 - 300 18 elevated as the low molecular weight resin does not have
- 1. . . . 19 a plasticising effect, the opposite effect is seen as the
 - 20 glass transition temperature of the material is elevated.

21

- 22 The material is generally transparent or clear, however
- 23 dyes may be added to change the appearance of the
- 24 material.

- 26 Low molecular weight in resins is a function of the.
- 27 length of the chains in the resin. In this case the
- 28 hydrocarbon resins have a very low molecular weight, too
- 29 low in fact for the resins to be of any use on their own,
- 30 and are difficult to mould. By mixing low molecular
- 31 weight hydrocarbon resin with polystyrene, the stress
- 32 limit of the polystyrene is reduced giving the material
- 33 the characteristics described in the present Application.
- 34 Preferably the low molecular weight resin will have a Mn

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(number average molecular weight) such that it has less 1

13

- than 500 repeating units, and preferably less than 50 2
- repeating units.

4

- The following is an example of the material of the 5
- 6 present invention.

7

- 8 Example 1
- 9 In order to achieve a material with a stress limit of 24
- 10 Mpa, a 50% mix of polymer and 50% resin is used, which
- acheieves this stress limit. Typically the polymer could 11
- be crystal polystyrene such as Polystyrol** 143E, and
- 13 resin Plastolyn™ 240.

- 20 98 11 15 Example 2
- Active 16 In order to achieve a material with abstress limbte of 34 Page 18 18
- 38 30 38 18 Cacheieves this stress limit. Typically the polymer could 30 30 30 30
 - 143E, and a Polystyrene such as Polystyrol** 143E, and
 - . 20 resin Plastolyn® 240.

21

- 22 Further modifications and improvements may be added
- without departing from the scope of the invention herein
- 24 intended.

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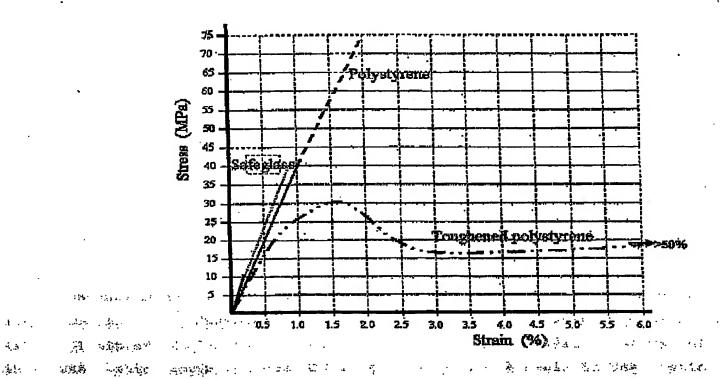


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